WRITTEN REPLY

To Mr. Hidekazu Yoshizawa, Examiner at the Patent Office

1. Display of International Application
   PCT/JP03/12863

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5. Content of Reply

(1) We have received the PCT opinion as provided in accordance with article 13 (PCT regulation 66) of the law relating to, for example, international applications based on the Patent Cooperation Treaty, and we reply as follows.

(1) The present invention is as noted in the Written Amendments (appended separately) submitted together with this Written Reply.

① Regarding claims 1 and 2, we have clarified by amendment that the transition of the mixture obtained in the preliminary step to the kneading step is carried out in a heated state of a temperature that is

lower than the softening temperature of the thermoplastic resin. That the transition to the kneading step is performed in a heated state of a temperature that is lower than the softening temperature of the thermoplastic resin is disclosed for example on page 11, lines 12 to 15[1] of the specification as originally filed.

② According to new claim 39, the stirring speed in the preliminary step is 400 to 1000 rpm. That the stirring speed in the preliminary step is set to 400 to 1000 rpm is disclosed on page 9, lines 18 and 19[2] of the specification as originally filed.

③ According to new claim 40, the additive is a particulate additive. That a particulate additive is used as the additive of the present invention is disclosed, for example, on page 2 line 24 to page 3 line 12[3] of the specification as originally filed.

④ According to new claim 41, the mixture obtained in the preliminary step is a homogeneous mixture of the additive and a thin film of the thermoplastic resin. And new claim 42 adds to claim 41 that the thin film is formed in the preliminary step by heating pellets of the thermoplastic resin. That the mixture obtained in the preliminary step is a homogeneous mixture of the additive and a thin film of the thermoplastic resin and that the thin film is formed in the preliminary step by heating pellets of the thermoplastic resin is disclosed, for example, on page 12 lines 6 to 18[4] of the specification as originally filed as well as by the statements in the Working Examples.

⑤ According to new claim 43, the mixture obtained in the preliminary step is a homogeneous mixture of the additive and a powder of the thermoplastic resin. That a powder of the thermoplastic resin and the additive are mixed is disclosed, for example, on page 9 lines 22 to 24[5] of the specification as originally filed.

(2) The Examiner held that the invention of the present application lacks novelty and inventive step over Document 1 (JP 2003-511506A),

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[1] corresponds to page 11, lines 12 to 17 of the English translation
[2] corresponds to page 9, lines 20 and 21 of the English translation
[3] corresponds to page 2, line 33 to page 3, line 21 of the English translation
[4] corresponds to page 12, lines 1 to 16 of the English translation
[5] corresponds to page 9, lines 26 to 28 of the English translation

Document 2 (JP H11-172009A), Document 3 (JP S63-189222A), Document 4 (JP S63-133501A), Document 5 (JP S53-128068A), Document 6 (JP S50-144738A), Document 7 (JP S49-4298A), Document 8 (JP 2002-256118A), Document 9 (JP 2002-128969A) and Document 10 (JP 2001-307551A). However, we believe that with the afore-mentioned amendments, the differences to the Documents 1 to 10 become clear, so that there is novelty and inventive step over these documents. This explained in more detail in the following.

(3) Discussion of the Invention of the Present Application

As noted in amended claims 1 and 2, the invention of the present application is as follows:

"1. A manufacturing process for a resin composition comprising a kneading step of kneading a thermoplastic resin and an additive under heating, wherein, prior to the kneading step, the manufacturing process further comprises a preliminary step of pre-heating and mixing the thermoplastic resin and the additive, and transition of the mixture obtained in the preliminary step to the kneading step is carried out <u>at a temperature that is lower than a softening temperature of the thermoplastic resin while maintaining a temperature reached at the end of the preliminary step</u>, and then kneading is carried out.

2. A manufacturing process for a resin composition comprising a kneading step of kneading a thermoplastic resin and an additive under heating, wherein, prior to the kneading step, the manufacturing process further comprises a preliminary step of pre-heating and mixing the thermoplastic resin and the additive, and the mixture obtained in the preliminary step is transitioned to the kneading step <u>in a heated state at a reduced temperature that is lower than a temperature reached at the end of the preliminary step and lower than a softening temperature of the thermoplastic resin</u>, and then kneaded."

Having these features, it is possible to knead microparticles and low-temperature decomposable additives homogeneously into a resin with the invention of the present application.

(4) Discussion of the Documents 1 to 10

As noted in its claim 1, Document 1 relates to:

"A manufacturing process for a thermoplastic polymer mixture derived from polycarbonate, thermoplastic polyester and/or vinyl polymer and optional additives, characterized by:

– a step of directly removing at least one thermoplastic substance used for the manufacture of a polymer mixture from a primary manufacture in a melted state;

– a step of optionally melting admixed components to be added;

– adding the admixed components to be added into the polymer that has been removed by melting from the primary manufacture;

– a step of mixing all components in a mixing section; and

– a step of cooling the polymer melt and optionally pelletizing it."

As noted in its claim 1, Document 2 relates to:

"A manufacturing process of a resin composition comprising (A) a thermoplastic resin and (B) a liquid substance that is in a liquid state over a temperature range of 25°C to 300°C, characterized in that, first, when taking the melting point (Tm) as the criterion if (A) is a crystalline resin and taking the glass transition temperature (Tg) as the criterion if it is an amorphous resin, lowering the Tm or Tg of (A) by 10°C to 200°C by mixing (A) and (B) at a temperature selected from a temperature range ranging from the temperature at which (B) becomes liquid to 300°C, and then performing melt extrusion using a melt extruder at 150°C to 300°C."

As noted in its claim 1, Document 3 relates to:

"A thermoplastic resin compound extrusion method characterized in that a mixture of a solid micro-powder and a thermoplastic resin powder particles is heated under stirring to a temperature of at least the melting point of the resin while furnishing heat from outside in a rotary high-speed flow mixer, a granulate is produced in which the solid micro-powder adheres to the surface of the thermoplastic resin powder particles, after which the desired extrusion molded product is obtained by passing that granulate through a rotary surge tank while maintaining the temperature of the granulate at at least the melting point of the

thermoplastic resin and supplying a constant amount of the granulate to an extruder while preventing caking."

As noted in its claim 1, Document 4 relates to:

"A manufacturing process for a PTC composition made by kneading at least one polymer and conductive particles and uniformly dispersing the particles in the polymer, wherein, to knead the polymer with the particles, the particles are kneaded into the polymer with a kneader, and then the particles are uniformly dispersed in the polymer with two rolls."

As noted in its claim 1, Document 5 relates to:

"A method for introducing glass fibers into a thermoplastic plastic, characterized in that when introducing glass fibers into a thermoplastic plastic by blending the glass fibers continuously into a melted thermoplastic plastic, molding the mixture into a fibrous, band-shaped or similar product, and optionally disintegrating [the mixture] to turn [the mixture] into particles, chips or similar, the glass fibers are pre-heated to a temperature that is lower than the melting point of the plastic or a temperature close thereto, and then the pre-heated glass fibers and the already melted plastic are given into a pre-mixing dome, in which they are mixed, and then this pre-mixture is continuously and directly supplied to a 2-stage degassing screw extruder."

As noted in its claims, Document 6 relates to:

"A manufacturing process for a thermoplastic resin composition including a filler, characterized in that a thermoplastic resin and a filler are continuously supplied to a screw extruder while pre-heating and kneading [the thermoplastic resin and the filler] in a device having a heating cylinder with an integrated screw and a shear discharge port continuous [to the heating cylinder], and furthermore melt-kneading and extruding [the thermoplastic resin and the filler]."

As noted in its claims, Document 7 relates to:

"A manufacturing process for a thermoplastic resin composition containing a filler, characterized in that an olefin resin, non-olefin-resin thermoplastic resin particles having a higher softening temperature than that olefin resin, and a powdery filler in an amount of 1 to 20 times by weight of the olefin resin are kneaded at a temperature that is at least the softening temperature of the olefin resin and lower than the softening temperature of the thermoplastic resin, the olefin resin in which the powdery filler is dispersed is caused to adhere to the surface of the thermoplastic resin particles, and then kneading is performed at a temperature that is lower than the softening temperature of the olefin resin, to obtain a particulate."

Documents 8 to 10 relate to resin compositions to which a flame retardant is added, and disclose that these resin compositions can be used for cable coating.

(5) Comparison of the Invention of the Present Application with these Documents

The Examiner has held that in each of the inventions disclosed in Documents 1 to 7, the transition from the preliminary step to the kneading step is made while maintaining a heated state, so that the inventions according to claims 1 to 36 of the present application are no different from the inventions disclosed in Documents 1 to 7, and therefore lack novelty. The Examiner has further held that using the kneaded mixture of the thermoplastic resin and the additive as a cable coating is widely known in the art, as disclosed in Documents 8 to 10, so that the inventions according to claims 37 and 38 lack inventive step. However, it should be evident that the present invention is different from Documents 1 to 10, as is detailed in the following.

① Regarding claims 1 and 2:

As noted in claims 1 and 2, the invention of the present application differs from the inventions in Documents 1 to 10 with regard to the fact that it includes a preliminary step of pre-heating and mixing the thermoplastic resin and the additive prior to the kneading step and the transition to the kneading step is carried out in a heated state whose temperature is lower than a softening temperature of the thermoplastic resin. In particular, this is as follows:

First of all, the preliminary step of the invention of the present application, which is carried out "prior to the kneading step" as noted in claims 1 and 2, is not a kneading step. "Kneading", as explained for example in "Plastic DAIJITEN" [transl: Plastic Encyclopedia] (edited by the Plastic Encyclopedia Editorial Board, publ. by K.K. Kôgyôchôsakai, 1994) p. 456, is defined as "performing the act of melting and mixing by applying strong shear forces to a raw resin and plasticizers, stabilizers, fillers or the like in an extruder or any type of kneading machine, and homogenizing the overall system while reducing the size of agglomerations." That is to say, kneading means the operation of mixing the overall resin in a melted state. By contrast, in the preliminary step of the present invention as noted for example on page 2 line 25 to page 3 line 12[6] of the specification as originally filed, one of the object is to avoid excessive heat and to ensure that decomposition of the added particles due to heat is not likely to occur, so that this step is not performed in a state in which the entire resin is melted. There is no particular limitation to the constitution of the mixture that is obtained by the preliminary step of the present invention, as long as it is not a state in which the entire resin is melted, and the method to obtain such a mixture is not limited too, but the following is a more specific discussion, taking Working Example 1 as an example.

Page 12 lines 9 to 12[7] of the specification as originally filed states that "as the stirring progressed, molten PP pellets collided with the above-noted groove-and-ridge pattern on the inner surface of the Henschel mixer, thereby forming a melt film (a microscopic thin film of PP)." However, in this case, "molten" means that a molten state is temporarily created at the portion where the inner surface of the Henschel mixer is in contact with the resin pellet surface, since the resin pellet are changed into film shape, and does not refer to a state in which the entire resin is mixed as during kneading. It is obvious that when the entire resin is molten, the resin cannot be maintained in the thin film state, and consequently a uniformly stirred mixture of the resin thin film

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[6] corresponds to page 2, line 33 to page 3, line 21 of the English translation

[7] corresponds to page 12, lines 5 to 8 of the English translation

and the additive cannot be formed. Moreover, page 12 lines 13 to 15[8] of the specification as originally filed states that "at that moment, the bulk density of the stirred mixture was 0.3 to 0.4 g/cm^3 and its temperature was in the range of 100 to 300°C." However, the temperature of 100 to 300°C in this case is the temperature of the wall of the stirrer (the Henschel mixer), and is not the temperature of the entire stirred mixture. If the entire stirred mixture would be heated to 300°C, the entire PP (polypropylene) would melt completely, and the thin film state could not be maintained. Consequently, it is obvious to the person skilled in the art that the state of "a homogeneous stirred mixture of the PP melt film and wood flour" noted on lines 12 and 13[9] of the specification as originally filed is not attained. Moreover, the fact that the "100 to 300°C" is the temperature of the wall of the stirrer is disclosed by "after heating the stirrer to 200°C" on page 12 line 6[10] of the specification as originally filed.

The foregoing was a discussion taking Working Example 1 as an example, but as pointed out in the specification as originally filed, the present invention is not limited to this.

Thus, the present invention differs from Documents 1 to 10 with regard to the fact that prior to the kneading step, a preliminary step of pre-heating and mixing the thermoplastic resin and the additive is performed, separate from the kneading step. As pointed out by the Examiner, Document 4 for example states that in Working Example 1, after kneading the polymer with the conductive particles in a closed kneader, they are kneaded by two rolls at 160°C. However, this is two-stage kneading in which further kneading is carried out after a kneading step, and there is neither mention nor suggestion of the fact that a preliminary step as in the present invention is carried out prior to the first kneading step.

Furthermore, as described in claims 1 and 2, the invention of the present application includes the characteristic requirement, neither mentioned nor suggested in Documents 1 to 10, that the mixture obtained

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[8] corresponds to page 12, lines 10 to 12 of the English translation

[9] corresponds to page 12, lines 9 to 10 of the English translation

[10] corresponds to page 12, line 1 of the English translation

in the preliminary step is transitioned to the kneading step in a heated state whose temperature is lower than a softening temperature of the thermoplastic resin, and then kneaded. That this characteristic requirement is neither mentioned nor suggested in Documents 1 to 10 is due to the fact that the idea of transitioning the mixture of the thermoplastic resin to the kneading step at an appropriate heated state, as in the present invention, did not exist in the prior art. More specifically, this is noted on page 2 line 25 to page 3 line 5[11] of the specification as originally filed. Mixing the thermoplastic resin and the additive prior to kneading them was performed in the prior art, but when transitioning to the kneading step, they were given into an extruder or the like at room temperature and kneaded, since it is difficult to handle heated mixtures. Therefore, it occurred that the additive particles caked together and homogeneous kneading was difficult. Moreover, caked additive particles obstruct thermal conduction, so that it is necessary to set the heating temperature of the extruder or the like much higher than the melting point of the resin when kneading, and there was the risk of thermal decomposition of the additive.

In contrast, with the present invention, due to the above-noted characteristic structural requirement, a superior effect is attained that is neither mentioned nor suggested by Documents 1 to 10. That is to say, as noted for example on page 2 line 25 to page 3 line 12[12] of the specification as originally filed, caking of the additive particles and thermal composition are not likely to occur, so that a resin composition of high quality can be manufactured. More specifically, as stated in Working Examples 17 to 22, for example, it is possible to admix a flame retardant and to obtain a resin composition that is superior over conventional products with regard to flame resistance, mechanical strength and costs. Furthermore, as noted for example on page 14 line 24 to page 15 line 8[13] of the specification as originally filed, it is possible to knead wood flour into a resin with a high melting point, such as PP,

[11] corresponds to page 2, line 34 to page 3, line 8 of the English translation

[12] corresponds to page 2, line 34 to page 3, line 19 of the English translation

[13] corresponds to page 14, lines 2 to 17 of the English translation

without causing carbonization. Furthermore, it is also possible to obtain a resin composition that is superior with regard to its mechanical strength by mixing a large amount of wood flour of 20 to 51 wt% of the overall resin composition. This effect is neither mentioned nor suggested in Documents 1 to 10.

Thus, the invention as described in claims 1 and 2 of the application includes characteristic structural requirements that are not mentioned in Documents 1 to 10, and the person skilled in the art could not have easily arrived at these characteristic structural requirements from these documents, so that claims 1 and 2 are novel and inventive over Documents 1 to 10.

② Regarding Claims 3 to 43

The inventions according to claims 3 to 43 all refer directly or indirectly to claims 1 or 2, so that for the reasons given above, they are novel and inventive over Documents 1 to 10. In particular the inventions according to claims 5, 9, 19 to 23, 41 and 42 have further characteristic features and thus display further superior effects.

(i) Regarding Claims 5 and 19 to 23

The inventions according to claims 5 and 19 to 23 are:

"5. The manufacturing process according to claims 1 or 2, wherein the mixture at the time of transition to the kneading step has a temperature in the range of 30 to 200°C."

and

"19. The manufacturing process according to claims 1 or 2, wherein the additive comprises an inorganic flame retardant, and at the time of transition to the kneading step, the mixture has a temperature in the range of 50 to 150°C.

20. The manufacturing process according to claims 1 or 2, wherein the additive comprises magnesium hydroxide, and at the time of transition to the kneading step, the mixture has a temperature in the range of 50 to 150°C.

21. The manufacturing process according to claims 1 or 2, wherein the additive comprises magnesium hydroxide and aluminum hydroxide, and at the time of transition to the kneading step, the mixture has a

temperature in the range of 50 to 130°C.

22. The manufacturing process according to claims 1 or 2, wherein the additive comprises plant tissue-derived powders, and at the time of transition to the kneading step, the mixture has a temperature in the range of 30 to 100°C.

23. The manufacturing process according to claims 1 or 2, wherein the additive comprises wood flour, and at the time of transition to the kneading step, the mixture has a temperature in the range of 50 to 100°C."

As already noted above, the present invention includes the characteristic requirement, neither mentioned nor suggested in Documents 1 to 10, that the mixture obtained by the preliminary step is transitioned to the kneading step in a heated state at a temperature that is lower than the softening temperature of the thermoplastic resin, and then kneaded. Therefore, as noted above, the superior effect, neither mentioned nor suggested in Documents 1 to 10, is attained that a high-quality resin composition can be manufactured in which caking of the additive particles and thermal decomposition of the additive particles is not likely to occur.

With the inventions according to claims 5 and 19 to 23, the temperature at the time of transition to the kneading step is set specifically to a range that is lower than the softening temperature of the thermoplastic resin, and in accordance with the type of the additive, so that the above-noted effect becomes even more pronounced. Thus, the characteristic structural requirement that the temperature of when transitioning to the kneading step is set specifically to a range that is lower than the softening temperature of the thermoplastic resin and the superior effect that is attained thereby is neither mentioned nor suggested in Documents 1 to 10, and could not have been easily thought of by the person skilled in the art.

(ii) Regarding Claim 9

The invention according to claim 9 is:

"The manufacturing process according to claim 7, wherein the inorganic flame retardant has a content of particles with a particle size of 0.70 to 15.0 μm of at least 90.0%."

It should be noted that the invention according to claim 7 relates to "the manufacturing process according to claims 1 or 2, wherein the additive comprises an inorganic flame retardant."

In addition to the afore-mentioned differences, there are the following differences between the invention according to claim 9 and the inventions in Documents 1 to 10:

In the invention according to claim 9, the particle sizes of the inorganic flame retardant are made small and uniform such that the content of particles with a particle size of 0.70 to 15.0 μm is at least 90.0%, whereby it is possible to manufacture a resin composition that is particularly superior with regard to flame resistance and mechanical strength, as noted in Working Examples 17 to 19 for example. This characteristic requirement and superior effect are neither mentioned nor suggested in Documents 1 to 10.

Conventionally it used to be believed that if an inorganic flame retardant is used whose particle size is as fine and uniform as possible, then also the mechanical strength of the resin composition is not likely to be lowered, and the specific surface area becomes large, so that flame resistance can be achieved also with a lower amount of additives. However, based on this thinking, it is difficult for the person skilled in the art to arrive at the invention of claim 9. This is because as noted on page 1 line 18 to page 2 line 1[14] of the specification as originally filed, the finer the particle size of a powder becomes, the more prone it is to caking due to absorption of moisture or the like, so that it is difficult to knead that powder uniformly into the resin, and there is the risk that the flame resistance is compromised or the mechanical strength decreases.

With the invention according to claim 9, an inorganic flame retardant with fine and uniform particle size can be kneaded into the resin composition without caking, so that it is possible to manufacture a resin composition with superior flame resistance and mechanical strength. As mentioned above, this effect is due to the fact, neither mentioned nor suggested in Documents 1 to 10, that the mixture obtained by the preliminary step is transitioned to the kneading step in a heated state at a temperature that is lower than a softening temperature of the

[14] corresponds to page 1, lines 26 to 36 of the English translation

thermoplastic resin, and then kneaded.

Therefore, the invention according to claim 9 cannot be easily derived by a person skilled in the art from the Documents 1 to 10.

(iii) Regarding Claims 41 and 42

The inventions according to claims 41 and 42 are:

"41. The manufacturing process according to claims 1 or 2, wherein the mixture obtained in the preliminary step is a homogeneous mixture of the additive and a thin film of the thermoplastic resin.

42. The manufacturing process according to claim 41, wherein the thermoplastic resin is pellet-shaped at the beginning of the preliminary step, and in the preliminary step the pellets are formed into a thin film by heating."

Due to having this constitution, with the inventions according to claims 41 and 42, it is possible to obtain a homogeneous mixture of the thermoplastic resin and the additive without using a powder-shaped thermoplastic resin, so that the resin composition can be manufactured at low cost.

In addition to the afore-mentioned differences, the inventions described in claims 41 and 42 differ from the cited documents with regard to the fact that the mixture obtained in the preliminary step is a homogeneous mixture of the additive and a thin film of the thermoplastic resin, and the fact that according to claim 42, pellets are formed into a thin film by heating.

In the conventional art, it was regarded as common sense that to mix a thermoplastic resin and an additive uniformly, a powdery thermoplastic resin should be used or mixing should be performed while the entire thermoplastic resin is completely molten. This is because otherwise it was difficult to mix the thermoplastic resin and the additive uniformly. However, powdery thermoplastic resins are more expensive than, for example, pellets.

That in the preliminary step of the present invention it is also possible to use a powdery thermoplastic resin is noted on page 9 lines 22

to 24 [15] of the specification as originally filed. However, the homogeneous mixture of the additive and a thin film of the thermoplastic resin mentioned in claim 41 can be obtained even without using an expensive powdery thermoplastic resin, and can be obtained inexpensively for example by forming the pellets according to claim 42 into a thin film by heating. There is no particular limitation regarding the method for forming pellets into a thin film by heating, and it is possible to form them into a thin film for example in the manner described in the working examples.

In the conventional art, it used to be common sense that the resin pellets should be completely molten when used, and Documents 1 to 10 contain neither mention nor suggestion of the fact that pellets are formed into a thin film by heating in a preliminary step, like in claim 42. The usage disclosed in claim 42 was first found by the inventors, and could not have been easily arrived at by a person skilled in the art.

(iv) Conclusion

In conclusion, we believe that the present invention is novel and inventive over Documents 1 to 10.

6. List of Appended Documents

(1) Written Amendments 1 copy

[15] corresponds to page 9, lines 26 to 28 of the English translation